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IN TWO SECTIONS

Section I

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EDITORIAL DEPARTMENT NOTE

Few industries have the problem of job costing to the extent that it exists in the manufacture of airplanes. Large units of product composed of numerous sub-assemblies and parts, frequent model changes and individual variations in planes of the same model make necessary most detailed accumulations of costs on a job basis. How this is handled in one large company in the industry is described in the first article in this issue of the *Bulletin*. Equally difficult problems, but of a different type are faced by the companies operating air lines. Proration of revenues and expenses to routes extending from coast to coast, control of equipment and supplies, and the proper estimation of depreciation and obsolescence on equipment which is being improved rapidly are some of the problems discussed in our second article.

The author of the first article, George M. Ebert, is a native of St. Louis, Missouri, where he is now located. He began his business career as Cost Accountant with the Monarch Metal Weatherstrip Co. of St. Louis, leaving the company in 1929 to become Accountant for the Wright Aeronautical Corp. From 1931 to 1932, he served as Assistant Treasurer of the Curtiss-Wright Airplane Co. in St. Louis, and in 1932, assumed the duties of Treasurer of the company with plants located in Robertson, Mo., and Wichita, Kan. In 1936, with the dissolution of this company, he took over his present duties as Assistant Treasurer of the St. Louis Airplane Division of the Curtiss-Wright Corp. Mr. Ebert has been active in the management of the St. Louis Chapter, having served as Treasurer from 1934 to 1937, and as Vice President during the current year.

T. J. Dunnion, the author of our second article, gained his early business experience in the automobile industry as Controller of several of the subsidiaries of General Motors Corp. He also served with the Aviation Corporation of America before transferring in 1930, to his present company, American Airlines, Inc., where he holds the position of Vice President and Treasurer. The present article was given as a talk before the Washington Chapter.

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COST ACCOUNTANTS

AUGUST 1, 1938

COST ACCOUNTING FOR AIRPLANE PRODUCTION

By George M. Ebert, Assistant Treasurer,
Curtiss-Wright Corp., St. Louis, Mo.

THERE are many ways and means of arriving at the same answer. However, in considering cost accounting for airplanes, I am going to confine myself to a discussion of the methods used in our factory.

New developments play an important part in the airplane industry. Therefore, in order to follow our procedure in its proper sequence, I will try to follow an imaginary development through the various stages of engineering and shop fabrication by discussing separately:

1. Accounting for new developments
2. Accounting for capital and extraordinary expenditures
3. Accounting for production costs

1. New Developments

New developments, whether in the airplane industry or any other industry, do not just happen. First of all there must be a need for the new product; second, the cost of obtaining it must be commensurate with the returns to be realized; and third, it must be economically possible to finance the undertaking, either by one company or a group of companies.

Naturally, in giving considerations to these three points, it follows that a complete study must be made which will disclose:

1. The probable market that can be realized
2. The probable cost of the development
3. The approximate time to complete the development

The fact that management uses these factors in determining whether or not to authorize a new development, immediately suggests that the information compiled during the development must portray the progress being made as compared to the plan on which management acted.

In order to present as accurate a picture as possible, the probable cost is broken down into as many major details as practicable, indicating the estimated cost for each detail, thereby giving us our

first breakdown of costs to be used as a gauge for our activities. As an illustration, the estimate is usually broken down as follows:

1. Engineering and Research Costs
   a. Designing and Drafting
   b. Wind Tunnel Tests
   c. Mockup
   d. Structural Tests
   e. New Equipment
   f. Flight Tests
2. Shop Fabricating Costs
   a. Direct Material
   b. Direct Labor
   c. Direct Overhead
   d. Special Jigs and Fixtures
   e. Special Heavy Tools

As there may be several new developments in process at the same time, we have established several series of order numbers covering the engineering and research costs enumerated above. These order numbers bear no relation to our regular production orders, but are established so that the type of expense can be readily identified and analyses prepared quickly. These series are grouped as follows:

Order No. Series	
50,000	Shop labor and material for engineering development and experimental work
60,000	Engineering department designing and drafting labor
70,000	Extraordinary expenses and capital asset expenditures

When management authorizes a new developmental or experimental work, order numbers in the proper series are immediately assigned to each detail of the estimate. As an illustration, item (a), "Designing and Drafting," would have an order number assigned in series 60,000, indicating that it is engineering labor, and item (d), "Structural Tests," would have an order number assigned in series 50,000, indicating it is shop labor and material

for engineering development or experimental work. When the order numbers are assigned, the accounting department is ready to gather the expenditures as they occur. With the type of expense indicated by the order number, this can be accomplished quite easily.

As most new developments cover a long period of time, we believe it is sufficient to make a summarized report at the end of each month, as shown in Exhibit A at the end of this article. (The money values shown in all exhibits are fictitious and for purposes of illustration only.) The monthly summary of expenditures enables management to follow the cost of development from month to month as compared to the original estimate. However, the men in charge of the various details have a problem of their own in keeping the cost of the many individual details from finally exceeding their estimate of the total cost.

In order to keep the department heads informed of the detailed cost, we prepare a weekly report of the detailed costs as shown in Exhibit B. This statement is furnished the day following the end of each week to the men responsible for the expenditures, and informs everyone of the progress being made. The percentage completed is estimated by the department doing the work. A study of this report will indicate that it supplies the answers to most questions asked by management. Some of the questions are as follows:

1. What non-productive orders are in the shop?
2. How much are these jobs costing us per week?
3. How close to being completed is the order for this or that?
4. Are the orders costing more than we anticipated?
5. What is responsible for the excess cost—material or labor?

In addition to the above mentioned report on the total cost of each order, we have found that an individual order is very desirable, especially where the order is made up of many separate items of sizeable amounts which could very easily get out of control. Consequently, on some orders we furnish a detailed report of the individual order. For example, the report covering Order 50,200, "Mockup," on illustrated model is shown in Exhibit C. This weekly statement is furnished to each department head having any responsibility on any of the details, a day after the end

of each week, and enables them to keep close control over the amount of money spent on each detail.

The term "Mockup" covers the fabrication and assembly of a full-size model of the article being designed and is used to prove the various arrangements and combinations prior to producing the article in its finished form. The mockup is used to good advantage by the engineering force and reduces to a minimum the amount of changes necessary in the fabrication of the finished article. As the mockup is necessarily completed long before the first production item, it is used quite extensively by the sales department in showing the actual arrangement and design to prospective customers.

The cost of all development expense is closed each month either to an expense account or to a deferred development account, depending on the nature of the development. However, the monthly reports shown keep accumulating the cost so that at all times the total cost of each detail is available.

So that management may have a quick total of all expenditures for development and research expense for each month and for the year to date, these costs are shown in total in our monthly engineering department expense statements, classified as follows:

	Current Month	*Previous Month*	*Year to Date*
Engineering Department			
Executive Salaries	$.....	$.....	$.....
Clerical and Stenographic	.....	.....	.....
Designing and Drafting	.....	.....	.....
Blueprinting	.....	.....	.....
Traveling Expense	.....	.....	.....
Experimental Expense, et cetera	.....	.....	.....
TOTAL			
Less Development and Experimental Deferred	.....	.....	.....
TOTAL EXPENSE CHARGED OFF	.....	.....	.....

You will note that the item "Less Development and Experimental Deferred" is deducted from the engineering department expense. This item represents the total amount of expenses that have been deferred. However, the total expenses are shown for additional control and for the information of management. As stated previously, at the time the development was authorized, the probable market had been established; therefore, management

has a clear picture on which to base the amount of development expense to be amortized over any period. As a general rule this is established on the basis of the estimated units to be sold, and is carried as a deferred expense and written off on each unit sold until the estimated number of sales have been made, or charged off when the facts are known as to whether any will be sold.

2. Capital and Extraordinary Expenditures

Before any capital expenditures or extraordinary expenditures can be made, an estimate of the total cost must be prepared and submitted to the general manager for his approval. After being approved, a separate order number is assigned. Weekly reports are made, similar to Exhibit B. These orders are closed each month either to expense accounts or to asset accounts depending on the type of expenditures.

3. Shop Production Costs

In spite of the eternal vigilance maintained in attempting to design parts so that they can be manufactured as reasonably as possible and still maintain the best aerodynamic efficiency, occasionally some parts are designed that cost considerably more to produce than originally contemplated. In order to give management an opportunity to review these items when the first experimental airplane is built, we use the same procedure of accumulating the cost of fabricating the first experimental airplane in our shop as we do subsequent production runs. Therefore, the following procedure applies to both types of construction.

An airplane consists of many small parts assembled into a relatively small number of major units that can be handled and sold separately. Consequently, most airplane manufacturers accumulate their costs on their production by major assemblies separated by function, such as structural parts, fixed equipment and extra equipment. This is accomplished by establishing unit designating numbers as follows:

0 *Wing Group*
01 Upper Wings
02 Center Wings
03 Lower Wings
04 Ailerons

1 *Tail Group*
- 11 Stabilizer
- 12 Fin
- 13 Elevator
- 14 Rudder

2 *Body Group*
- 21 Fuselage
- 22 Baggage Compartment

3 *Landing Gear*
- 31 Main Landing Gear
- 32 Tail Wheel Gear

4 *Power Plant Group*
- 41 Engine and Accessories
- 42 Fuel System
- 43 Oil System

5 *Fixed Equipment*
- 51 Instruments and Boards
- 52 Seats
- 53 Air Controls
- 54 Electrical Equipment

6 *Extra Equipment*
- 61 Radio
- 62 Oxygen Equipment
- 63 Photographic Equipment
- 64 Flare Equipment

The list of numbers shown is not complete but is enough to show the unit grouping and can be broken down into three numbers to get detailed costs, for example:

42 *Fuel System Assembly*
- 421 Main Gas Tank
- 422 Lines and Connections

We try to have our part numbers and engineering blueprint numbers incorporate this unit number so that the part number will immediately identify the major assembly on which it is used. For instance, in drawing the part for a wing, the engineers will assign a part number—19-03-1. The part made from this print can easily be identified as belonging to Model 19; lower wing (03)

and the first detailed drawing. As is apparent, this saves considerable time in the engineering, fabricating, inspection and time-keeping departments.

Release of Orders for Production

When an airplane order, either experimental or production, is ready for fabrication, the engineering department prepares a list of all blueprints covering the parts necessary to construct the airplane. When the order is released to the shop for fabrication, the engineering department forwards this list to the production department. The production department then proceeds as follows:

1. Assigns order number and prepares schedule
2. Prepares work order
3. Prepares route tag
4. Prepares requisitions

The production department being informed as to the delivery schedule, prepares a master production schedule indicating when each major unit is needed. After the master production schedule is completed, a schedule of the detailed parts in each department is prepared so that a complete picture of what must be done to accomplish the production schedule is available.

Assigning Order Numbers

In assigning order numbers for production we follow the general idea of using a letter of the alphabet to designate the particular model of the airplane, together with numbers in units of ten, indicating the particular order and type of charge. This can best be illustrated as follows:

A—First model
B—Second model
C—Third model
D—Fourth model
E—Fifth model
et cetera

This letter is assigned to the basic model and any variations in the model would be included in the letter assigned to the basic model.

The next part of the order number indicates the particular order and type of charge as follows:

11—First Experimental Production Order—Direct Labor, Overhead and Material
12—First Experimental Production Order—Special Tools and Jigs
13—First Experimental Production Order—Experimental Charges

The second order released would be

21—Second Order—Production—Direct Material, Labor and Overhead
22—Second Order—Production—Special Tools and Jigs
23—Second Order—Production—Miscellaneous Experimental Charges.

The third order released would be

31—Third Order—Direct Material, Labor and Overhead
32—Third Order—Special Tools and Jigs
33—Third Order—Miscellaneous Experimental Charges.
et cetera

For accumulating our costs and preparing our control information we complete the order number for each major assembly by adding the proper unit designating number referred to previously. Therefore, a production release to the shop fabricating the lower wings on Model A on the third production series would have order A31-03 assigned to it. The letter "A" and the first two numbers would appear in the order number of all major units of the airplanes being constructed, which immediately identifies each lot with the particular production order and permits the cost of the order to be compiled separately from any other series being fabricated at the same time. When the order is completed a cost summary is prepared as outlined in Exhibit I.

Work Order

The Work Order, Exhibit D, is prepared for each assembly as authority for the various departments to accomplish the necessary work. This order has all the necessary information normally needed by the shop foreman, a copy being sent to the head of

each department involved in fabricating the assembly. From the work order the foreman is able to prepare his plans so that he can meet his schedule.

Route Tag

A Route Tag, Exhibit E, is also prepared indicating the order number, part number, quantity, requisition, et cetera, which is delivered with the blueprints to the foreman starting the work. This route tag is attached to the parts when completed, for inspection, and stays with the parts until they are finally delivered to either the stockroom or to the assembly department.

Requisitions

A requisition, Exhibit F, in triplicate is also prepared covering the material needed. One copy of this requisition is delivered to the foreman with his work order, one copy is delivered to the stockroom immediately, and one copy is filed for reference. In addition to the regular information covering the order, model, quantity, et cetera, we indicate the date the material will be needed by the fabricating department. The date needed is established by the production department which takes into consideration stocks on hand, delays in delivery, priority of parts, et cetera, in establishing their master schedule and is the date on which they plan to have work start. By having this date shown, the stockroom can give immediate attention to all material needed at once and in the meantime, arrange for the delivery of material not so urgently needed. This also permits the foreman to give immediate attention to orders on which the material is available.

The copy of the requisition which is forwarded to the foreman is presented at the stockroom when material is delivered; it is used to post the disbursements in the stockroom inventory record and then forwarded to the accounting department for pricing, extensions, posting to the perpetual inventory records and entering in the cost records.

Time Tickets

Time tickets are prepared for each job and workman daily. These time tickets are gathered by the timekeeper and compared with the master clock card to account for all time. The time

tickets are then sorted by job orders for each department and a report is prepared for each department foreman as shown in Exhibit C. This report is forwarded to each foreman by noon of the day following the day reported and gives him a day by day comparison of hours worked in his department.

A summary of wage distribution by job orders and expense accounts is made each week showing the total labor for each order. As our overhead is figured as a percentage of direct labor, this summary also indicates the amount of overhead applied to each order. This summary is then posted to the cost sheets or expense accounts by departments.

We, of course, keep control accounts covering all costs in our general ledgers, and the necessary journal entry is made crediting accrued wages and salaries and charging the various cost control accounts.

Spare Parts

Many times it is desirable, when setting up various machines, to produce the total estimated requirements in order to effect a considerable saving in cost. There is also the problem of filling orders for spare parts. We have established a separate series of orders for this type of work which enables us to get the cost of any particular part or assembly. Our spare parts order series at the present time begins with the prefix "16D," indicating spare parts order, and each part is released on a separate number in consecutive order from 16D-1 to 16D-999.. When this group of numbers is exhausted we will use 16E-1, et cetera. When these orders are completed, they are closed into our detailed fabricated parts inventory and cleared on requisitions to the various orders on which they are used.

In order to intelligently follow each order through the shops, we have found it very desirable to establish an estimated cost for each order. So that everyone concerned can be informed promptly of their progress, we prepare a report, Exhibit G, indicating the man hours spent each day on each order in the various departments and the accumulated hours to date compared to the total estimated hours established. This report is furnished to each department head for his department and a copy of each

department to the plant superintendent by noon of the following day.

On production orders for airplanes we prepare each week a report, Exhibit H, indicating by groups the actual material and labor cost as compared to the original estimate. This report reveals the amount of work being done on each group each week and enables management to concentrate their efforts on the items that need attention.

From the foregoing statements it will be seen that management knows long before an order is completed whether or not the order will be produced as originally planned, and in addition, has an opportunity to do something about it while something can be done. Because of the reports prepared while the order is being fabricated, we are in a better position to forecast and supervise subsequent production.

EXHIBIT A

COST OF DEVELOPING ILLUSTRATED MODEL

Month Ending September 30, 1937

Order No.	*Description*	*Current Month*	*Previous Month*	*Actual Cost to Date*	*Estimated Total*
	ENGINEERING AND RESEARCH				
60100	Designing and Drafting.....	$18,000	$17,000	$ 90,000	.....
60101	Research	1,500	500	6,000	.....
		$19,500	$17,500	$ 96,000	$250,000
	WIND TUNNEL TESTS				
50100	Labor and Material to construct Airfoils	.....	$ 2,000	$ 2,500	.....
50101	Labor and Material to construct Airplane Model	$ 1,200	500	1,700	.....
60111	Engineering Labor	400	300	900	.....
75100	Purchased Services	3,000	2,000	5,000	.....
		$ 4,600	$ 4,800	$ 10,100	$ 10,000
	MOCKUP				
50200	Labor and Material to construct Mockup	$ 2,000	$ 1,500	$ 5,000	.....
50201	Purchased Materials (usable)..	500	.....	500	.....
		$ 2,500	$ 1,500	$ 5,500	$ 15,000
	STRUCTURAL TESTS				
50300	Rivet Test Panels.....	$ 100	$ 50	$ 1,000	.....
50301	Gas Tank Specimens.....	400	.....	400	.....
50302	Test Jig	250	.....	250	.....
50303	Wing Section Test.....	1,500	500	4,000	.....
		$ 2,250	$ 550	$ 5,650	$ 10,000
	TOTAL	$28,850	$24,350	$116,750	$285,000

EXHIBIT B

OPEN ORDERS CAPITAL AND EXTRAORDINARY EXPENSES

Week Ending September 29, 1937

Order No.	Description	% Comp.	Current Week Mat'l	Current Week Labor	Current Week Total	Actual Cost to Date Mat'l	Actual Cost to Date Labor	Actual Cost to Date Total	Estimated Total Mat'l	Estimated Total Labor	Estimated Total Total
50200	Mockup—Illustrated Model ...	39%	$1,100	$1,550	$2,650	$2,870	$3,880	$6,750	$5,380	$9,720	$15,000
50300	Structural Tests	42%	200	650	850	1,000	4,650	5,650	.....	.....	10,000
75100	Purchased Services on Wind Tunnel Work	....	.....	.....	2,000	.....	.....	5,000	.....	.....	5,000
75110	Purchase and Install Blueprint Machine	....	.....	.....	.....	.....	.....	.....	....	.....	5,000
77000	Make Wing Jigs.....	95%	100	400	500	200	1,100	1,300	200	1,300	1,500

EXHIBIT C

COST OF BUILDING MOCKUP ON ILLUSTRATED MODEL

Week Ending September 29, 1937

ORDER 50200

Order No.	Description	Current Week Mat'l	Current Week Labor	Current Week Total	Actual Cost to Date Mat'l	Actual Cost to Date Labor	Actual Cost to Date Total	Total Estimated Mat'l	Total Estimated Labor	Total Estimated Total
50200-1	Fuselage Chassis and Support	$ 100	$ 300	$ 400	$ 600	$ 700	$1,300	$ 750	$1,250	$ 2,000
-2	Fuselage Rings	50	100	150	300	400	700	200	800	1,000
-3	Flooring	....	....	....	70	30	100	80	20	100
-4	Cover on Fuselage	....	....	....	400	1,000	1,400	300	900	1,200
-5	Windows and Doors	100	300	400	100	300	400	500	1,000	1,500
-6	Pilots Compartment	....	500	500	100	500	600	1,500	3,000	4,500
-7	Seats, Partitions, etc.	100	100	200	200	100	300	600	900	1,500
-8	Wing Sections	150	100	250	150	100	250	150	350	500
-9	Nacelles	100	....	100	200	200	400	200	600	800
-10	Landing Gear	200	50	250	400	300	700	600	400	1,000
-11	Tail Unit	300	100	400	350	250	600	500	400	900
		$1,100	$1,550	$2,650	$2,870	$3,880	$6,750	$5,380	$9,720	$15,000

EXHIBIT D

SHOP ORDER

ORDER No. A31-03

ASSEMBLY NAME Wing Channel

ASSEMBLY No 19-03-01

QUANTITY NEEDED 50

MODEL 19

ISSUED BY John Smith CHECKED BY JD AIRPLANE Nos 101 to 149 DATE Aug. 5, 1937

QUANTITY PER AIRPLANE	PART No.	DESCRIPTION	QUANTITY NEEDED	REQUISITION No.	FINISH SPECIF.	TOOL No.	ESTIMATED MAN HOURS	DATE NEEDED	DATE COMPLETED
		Metal Shop							
1	19-03-01	Wing Channel					150	9/29/37	
	-03-02	Ribs	150	6950	3	T1215			
	-03-03	Extrusions	100	6950	3	T2301			
	-03-04	Gussets	300	6950	3	T1216			

EXHIBIT E

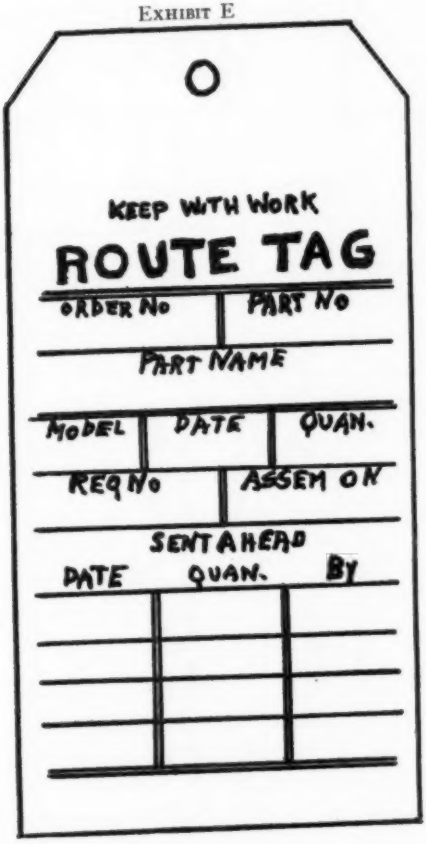
KEEP WITH WORK
ROUTE TAG
ORDER NO
PART NO
PART NAME
MODEL
DATE
QUAN.
REQ NO
ASSEM ON
SENT AHEAD
DATE
QUAN.
BY

EXHIBIT F

CW Form 14

Material Requisition

Shop Order No. A31-03 **Nº 6950**

File Copy

Deliver To	Part or Assy. No.	PART NAME	Model	SerialNo.	No. of Mches.
Department 1	19-03-01	Wing Channel	19		50

Date Needed	Quantity	Description	QUAN. SUPPLIED	PRICE	EXTEN.
9/20/37	50 pcs.	.032 24"x48" 24ST Alclad	400 sq.ft.	.30	$120.00
9/20/37	100 "	48" Extrusion Section #00	400 sq.ft.	.20	80.00

Signed John Smith

Date 9/5/37

ABOVE MATERIAL RECEIVED

By John Doe Date 9/20/37

EXHIBIT G

FORM CW 34

CURTISS-WRIGHT CORPORATION

St. Louis Airplane Division
Robertson, Missouri

DAILY DISTRIBUTION OF MAN HOURS

Dept. 6

ORDER No.	DESCRIPTION	HOURS TO 10-4-37	10-5-37	TOTAL HOURS TO DATE	ESTIMATED HOURS
A31	50 Model 19	25,920	750	26,670	36,050
A32	50 Model 19 - Tools	3,920	50	3,970	
16D91	Spare Parts - Fin	1,200	140	1,340	1,380
92	" " Rudder	700	130	830	1,260
93	" " Stab.	1,630	70	1,700	4,680
50200	Mockup	16,780	80	16,860	15,500
70000	Miscellaneous		160		
	et cetera				

EXHIBIT H

ACTUAL COST COMPARISON WITH ESTIMATED COST

SERIES A31

QUANTITY OF FIFTY

Week Ending September 27, 1937

No.	Description	Current Week			Actual Cost to Date			Estimated Total		
		Mat'l	Labor	Total	Mat'l	Labor	Total	Mat'l	Labor	Total
0	Wing Group	$.....	$.....	$.....	$.....	$.....	$.....	$.....	$.....	$.....
1	Tail Group	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	Body Group	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	Landing Gear Group	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	Power Plant Group	.....	.....	.....	.....	.....	.....	.....	.....	.....
5	Fixed Equipt. Group	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	Extra Equipt. Group	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	Nacelle Group	.....	.....	.....	.....	.....	.....	.....	.....	.....
9	Final Assembly	.....	.....	.....	.....	.....	.....	.....	.....	.....

EXHIBIT I

COST PER AIRPLANE OF SUBJECT AIRPLANES FABRICATED ON ORDER A31—QUANTITY OF 50

Work Started June 20, 1937—Completed December 13, 1937

		Cost per Airplane Material	*Cost per Airplane Labor*	*Cost per Airplane Overhead*	*Cost per Airplane Total*	*Estimated Cost*
		$.....	$.....	$.....	$.....	$.....
WING GROUP						
A31-03	Lower Wings	.....	.....	.....	.....	.....
05	Ailerons	.....	.....	.....	.....	.....
07	Flaps	.....	.....	.....	.....	.....
	TOTAL.....	.....	.....	.....	.....	.....
TAIL GROUP						
A31-11	Stabilizer	.....	.....	.....	.....	.....
12	Fin	.....	.....	.....	.....	.....
13	Elevator	.....	.....	.....	.....	.....
14	Rudder	.....	.....	.....	.....	.....
	TOTAL.....	.....	.....	.....	.....	.....
BODY GROUP						
A31-21	Fuselage	.....	.....	.....	.....	.....
26	Floor	.....	.....	.....	.....	.....
28	Baggage Compartment.	.....	.....	.....	.....	.....
	TOTAL.....	.....	.....	.....	.....	.....
LANDING GEAR GROUP						
A31-31	Main Gear	.....	.....	.....	.....	.....
32	Shock Struts	.....	.....	.....	.....	.....
33	Wheels, Tires and Tubes	.....	.....	.....	.....	.....
34	Tail Wheel Gear.....	.....	.....	.....	.....	.....
	TOTAL.....	.....	.....	.....	.....	.....
POWER PLANT GROUP						
A31-41	Engine Accessories ...	.....	.....	.....	.....	.....
42	Fuel System	.....	.....	.....	.....	.....
43	Oil System	.....	.....	.....	.....	.....
45	Exhaust System	.....	.....	.....	.....	.....
47	Propellers	.....	.....	.....	.....	.....
	TOTAL.....	.....	.....	.....	.....	.....
FIXED EQUIPMENT						
A31-51	Instruments	.....	.....	.....	.....	.....
53	Air Controls	.....	.....	.....	.....	.....
54	Stabilizer Controls	.....	.....	.....	.....	.....
56	Seats	.....	.....	.....	.....	.....
	TOTAL.....	.....	.....	.....	.....	.....
EXTRA EQUIPMENT						
A31-61	Radio	.....	.....	.....	.....	.....
63	Photographic Equipt. ..	.....	.....	.....	.....	.....
67	Oxygen Equipt.	.....	.....	.....	.....	.....
	TOTAL.....	.....	.....	.....	.....	.....
NACELLE GROUP						
A31-71	Engine Mount	.....	.....	.....	.....	.....
72	Engine Cowling	.....	.....	.....	.....	.....
73	Nacelle Structure	.....	.....	.....	.....	.....
	TOTAL.....	.....	.....	.....	.....	.....
	TOTAL FABRICATING COST PER AIRPLANE	.....	.....	.....	.....	.....

ACCOUNTING FOR AIR TRANSPORTATION

By T. J. Dunnion, Vice President and Treasurer, American Airlines, Inc., Chicago, Ill.

FUNDAMENTALLY, there is no difference between accounting for air transport and accounting for other forms of transportation. Several years ago there was considerable romance attached to the aviation business, and the accounting by each company reflected without entire uniformity its own idea of how the results should be shown.

The Standard Classification of Accounts

All of the present domestic air mail operators started business early in 1934 and have been operating under the Air Mail Act of 1934 since that time. All air mail contractors have been required to furnish monthly reports to the Post Office Department on standard forms prepared under a standard Classification of Accounts. At the time these uniform reports and accounts were originally installed by the Post Office Department there was very little operating background upon which to base an accounting system which would scientifically reflect the result of airline operations. In setting up the grouping of accounts and the forms which reflected the results, the systems in use by other forms of transportation were used as a background, and as more and more operating experience was acquired, the new Classification of Accounts and new forms were designed and furnished to all operators by the Post Office Department. The new system, which is the result of study of the past results and future requirements of all domestic air mail operators and the Post Office Department, has been in operation since July 1, 1937, and appears to be working out very satisfactorily.

Airline accounting, like accounting for all other business, boils down to the collection of revenue, the disbursement of expense, the proper recording of such transactions and the furnishing of such statements as will enable the management to control the business efficiently.

Our revenue is derived from two sources: the carriage of mail for the Post Office Department and the transportation of pas-

sengers, express and other cargo. Our expenses may be grouped into flying expense, ground cost, sales cost, general administrative cost, sundry expenses, including taxes and interest, and depreciation.

Air Mail Revenue

Under the Air Mail Act of 1934 bids were opened by the Post Office Department for domestic lines to serve the entire country, and operating under that Act there were certain routes authorized for bidding to serve the citizens of the various communities. The Interstate Commerce Commission was later given the task of determining fair and reasonable rates and the Post Office Department was authorized to designate the amount of mail service required on each route.

The revenue derived from the carriage of air mail is a substantial proportion of our total revenue and, naturally, the accounting for this service and the reporting to the Post Office Department is very important. For example, American Airlines now operates eight air mail routes extending from Boston to Los Angeles. Our transcontinental route is divided into three sections: Air Mail contract #4, Los Angeles to Fort Worth; Air Mail contract #23, Fort Worth to Newark; Air Mail contract #18, Newark to Boston. Each air mail route is credited with the air mail revenue earned by the route. In submitting our monthly reports to the Post Office Department we are required to show the miles flown, trip by trip, each day; the pounds of mail loaded and unloaded at each point; the pound miles flown; and pounds carried over the route day by day. The mileage used is determined by the Department of Commerce. The rates applying to these figures are determined by the Interstate Commerce Commission, and after the figures have been submitted to Washington and passed to the Accounting Department of the Post Office Department, they are forwarded to the General Accounting Office for approval, and payment is made in due course.

Air Mail Expense

On the expense side, the cost of operating the airplane up to the terminal point has to be determined. At points like Fort Worth, where air mail routes converge, an allocation of expense is re-

quired to be made to the three contract routes operating into that point. The ground expenses along the route are charged direct to the route; sales, advertising, administration, and other expenses are allocated on the various bases most equitable to the particular situation, as well as depreciation on the equipment flown over the line, and depreciation on ground equipment, radio, and other depreciation applicable, thus developing the cost of operating the contract route.

In addition to the air mail schedules which are designated by the Post Office Department, schedules for passengers only are operated. These are necessary to fill the public demand for service at times other than air mail schedule departures. In reporting to the Post Office Department we segregate the revenue from such operations and a composite report of all activities on each contract route is submitted in the form of a monthly profit and loss statement by routes.

Passenger Revenue

Within the last three years, due to the introduction of the modern types of equipment, new methods of flying and improved service to the public, passenger business has shown a remarkable increase. The number of passengers by years was:

1934	460,000
1935	746,000
1936	1,020,000
1937 (estimated)	1,200,000

With the extension of our sales offices and the introduction of the universal use of the Air Travel Plan, the accounting for passenger revenue has become our major task. A passenger today may purchase an airline ticket between any two airline points in the United States at any airline ticket office, at travel bureaus, at transportation desks of leading hotels, or he may make reservation at most Western Union and Postal Telegraph offices by telephone and tickets will be delivered by uniformed messengers and fare collected without extra charge. Airline tickets for use in the United States may also be purchased in the principal European countries. Arrangements may be made with steamship companies at foreign points of departure for exchange orders

which will be honored by all airlines in this country. Reliable firms may procure transportation for their employees under the Air Travel Plan which is in effect on practically all major airlines in the country. These volume users, through placing a substantial deposit, may obtain a reduction of 15 per cent from the published one way fare.

Generally, airline tickets are issued for one of the following:

Cash

Exchange Orders (These are the media through which agents, travel bureaus, steamship companies and other airlines give an order for transportation. They collect the cash at the time the order is issued.)

Travel cards issued under Air Travel Plan.

Government Transportation Requests (These are honored on all airlines at the rate of equivalent rail plus Pullman charges.)

The revenue for the use of an airline ticket is accounted for on a ticket sale basis except in the case of interline tickets issued by other airlines. This simply means that when transportation is sold by one of our own sales offices, by travel bureaus, by hotel porters, or by steamship companies, the value of this ticket is immediately credited to revenue. Later if any refunds are made, the amount of the refund is charged to the revenue account.

Using American Airlines as an illustration, when an interline ticket is sold by an American Airlines office for cash, we immediately take up as revenue the portion applying on our own line and set up a liability for the portion of transportation to be furnished by the connecting airline. This liability is retained until the billing is received from the connecting carrier. The reverse of this situation applies when interline tickets are sold by other carriers with the second portion of the journey over American Airlines. After long experience, this appears to be the most practical method of handling as the refunds and advance sales are fairly constant from month to month.

Since its introduction the Air Travel Plan has become very popular. At the present time approximately 40 per cent of our total passenger revenue is derived from this particular source in our own company. Responsible firms using a substantial volume of air travel may, by payment of a deposit, procure travel identifi-

cation cards for their employees traveling on company business. Upon presentation of his travel card and signing of a transportation receipt, he will be issued an airline ticket. These transportation receipts are charged to the air travel account and periodical billings are made for the amount of travel used.

Revenue is credited to the various air mail routes on an actual value basis, as shown by the routing on the ticket. If the ticket is used on two or more air mail routes, revenue is credited to the respective routes either on a mileage basis, if the total fare for the through ticket is less than the sum of the local fares applicable to each route, or on a local fare basis if the total fare equals the sum of the local fares. After the route revenue is determined, it is further broken down as between mail service and non-mail service on the ratio of passenger miles applicable to each type of service.

Express and Other Revenue

Air express and other cargo are carried on all trips, and these are properly identified in each monthly report. The volume of our air express cargo has been increasing rapidly from year to year. However, the revenue from this source is still a very small percentage of our total. The accounting for this type of revenue is very simple. The airlines merely perform the transportation of the goods for the Railway Express Agency under contract. The charges are made at the published tariff, and after deducting certain expenses, subject to audit by the airlines, and applying an agreed upon proration percentage, the net proceeds are turned over to the airlines each month, together with statement of revenue and expenses.

There are other incidental revenues, such as excess baggage, which are collected, reported and accounted for at the same time and in the same manner as passenger revenue.

Expenses

The expenses may be divided into six major groups:

(1) FLYING COST. This includes all charges in connection with keeping the plane in the air.

(2) GROUND COSTS.—This includes all salaries of operating personnel on the ground, as well as cost of ground radio

and other communications; rental of airports; repairs to all equipment other than airplanes, including buildings, machinery, etc.

(3) SALES AND ADVERTISING. This group includes salaries and expenses of sales personnel, rental of sales offices, cost of reservations departments, and advertising.

(4) GENERAL AND ADMINISTRATIVE. This includes salaries and expenses of general officers, general office accounting expense, legal expense, operating taxes including Social Security taxes, and items which are usually classified in this group by most other forms of business.

(5) OTHER CHARGES AND CREDITS. This group includes corporate taxes, interest, and items of a similar nature.

(6) DEPRECIATION. This group includes all charges for depreciation and obsolescence of both flying and ground equipment.

Flying Cost

Flying expenses include the maintenance and overhaul of flying equipment, salaries and expenses of flying personnel, fuel and oil used in flight, flight insurance, and other flight expenses, including principally passenger lunches and supplies.

All large airlines maintain their own overhaul and repair shops at which all major overhauls of airplanes and engines are made. The periods between overhauls of engines are approved by the Department of Commerce, and at the time each overhaul is started, job orders are opened for each individual overhaul. These job orders show the detail of the parts replaced, hours and cost of labor, and each month the total of orders completed, as well as orders in process, are charged to direct flying cost. In addition to this, ordinary maintenance and repairs may be conducted at any point on an airline system. The station payroll distribution is the medium through which the labor charges find their way into the flying cost. Materials are charged through requisition to standing job orders, and monthly charges are made to flying expense. The overhaul of aircraft radio, propellers, and instruments are handled in a similar manner through standing job orders.

The salaries and expenses of flying personnel, such as captains (pilots), first officers (second pilots), stewardesses, including their expenes while away from base, and compensation insurance, are direct charges to flying cost. The preparation of the captains' payroll is somewhat involved. The base pay is on a sliding scale, depending on length of service. The flying pay is based primarily on a rate per hour, varying with the speed of the ship, and with different rates for day and night flying. There is a further provision that for all miles flown at a rate over 100 miles per hour there is an additional bonus, and there is a sliding scale applying to these bonus miles, depending upon the total miles flown by a pilot in a given month. It will readily be seen that under this pay plan, which was originally ordered by the National Labor Relations Board and has been in use by all airlines for the last several years, the flying personnel are not penalized on account of flying the higher speed planes which are now in operation.

Fuel and oil is one of the major items of flying cost. Practically all airlines have gassing facilities at every point on their lines. Gasoline and lubricating oil are purchased under contract for delivery in bulk, generally either tank car or tank wagon. When deliveries are made by the oil company, the charge is to the inventory, and day to day issuance, after giving effect to shrinkage, is charged direct to flying cost each month.

Flight insurance, which includes fire and windstorm damage, passenger liability, public liability, property damage, and pilots' accident insurance, is also a major item of expense. The practice of all domestic airlines is to insure against legal liability in connection with the operation of its airplanes. The premium on this type of insurance is generally based upon passenger miles or airplane miles, depending upon the type of risk.

Prior to July 1, 1937, the risk of crash was provided for by most airlines by the creation of a reserve at a fixed rate per airplane mile. When crashes resulted, the charge was direct to the reserve. With the introduction of the new Classification of Accounts as of July 1, 1937, the reserves were eliminated, and at the present time all airlines are required to charge off such crashes if and when they occur. In the early days practically all airlines insured against losses from crash. The present practice is tending toward self-insurance against this risk. Our own company

has found it much cheaper to carry its own risk in this respect since 1933.

The balance of the flying expense is made up of cost of passenger lunches, supplies, and items of a similar nature. The sales department designates the schedules on which lunches are to be served. The passenger service department is responsible for providing the proper type of food. So far the airlines have not developed their own food service and this is being furnished by caterers who are under contract at flat rates per meal. When the catering bills are approved, the charge is direct to flying expense.

Ground Cost

Ground salaries include dispatchers, agents, and other cargo handling employees; plane servicing employees, including commissary; meteorologists; communications employees, including radio operators, flght control, maintenance superintendence, and all other employees on the ground necessary to keep the ships in the air. The distribution of this payroll is on a monthly basis, and is taken from time reports of each station, classified only according to position. In our company there is no distribution to job orders as in the case of mechanics, mentioned above. The balance of the ground expenses include telephone, telegraph, repairs to ground equipment, maintenance of fields, rental of airports, airway lighting and supplies, weather supplies, light and power, traveling expense of ground personnel and supervision, stationery, and other expenses incurred in the field by the ground personnel. Charges for some of these services are by contract; some are purchased locally along the route; other charges are through the medium of expense reports. After all bills have been approved locally, payment is made through the general office. In our own company we have 57 locations, and in addition to the consolidated expense statement of the system, we prepare a comparative statement of expenses at each point, which is used by the supervisory personnel as a medium of control.

Sales and Advertising

Sales and advertising is another major item of expense. It includes the salaries of our own personnel, commissions paid to

outside agents, telegraph and telephone expenses at sales offices, as well as incidental office expense. The advertising section is segregated into newspapers and periodicals, displays, folders, circulars, and memberships. The expenditures for advertising are generally controlled by budget. The larger airlines handle their advertising through an agency. The bills submitted by the agency are approved by the sales manager and generally are supported by tear-sheets. All sales and advertising bills, when approved, are paid through the treasury department and charged direct to the proper accounts.

General and Administrative Expense

This group includes salaries and expenses of general officers, general office, telephone, telegraph, light, heat, power, stationery, legal and other items of a general administrative nature. The accounting for this group is similar to accounting for similar classes of expense by other industries. The only item which might warrant comment is that Social Security taxes are included in general administrative expense along with other operating taxes.

The grouping "Other Income and Other Charges" includes items which are ordinarily included under this bracket by all companies. The "Income" items include discounts, interest, and dividends; the "Expense" side includes similar items not pertaining directly to operations.

Depreciation and Obsolescence

The largest item of expense is depreciation and obsolescence. Generally, this falls into two classes: depreciation on the flying equipment—airplanes, engines, propellers, and aircraft radio; and, depreciation on ground equipment—hangers, machinery, automotive equipment, ground radio, furniture and fixtures, and the usual auxiliary facilities. The rates of depreciation used for the latter group are in conformity with rates in ordinary usage.

In the early years there were several types of equipment in use: single motor, twin motor, and tri-motor, with varying seating capacities. Most of these ships were fabric covered, and the average rate of speed was low. During 1933 and 1934 all-metal ships of faster speed, and with longer cruising range, were introduced.

This quickly obsoleted a number of types of ships which were then being flown. About the same time the Department of Commerce prohibited the flying of passengers in single-motored equipment. These two factors obsoleted most of the equipment then in use. Since that time the trend has been toward standardization on the larger, more modern, faster, all-metal equipment, and as of today there is sufficient operating background by all domestic air mail operators upon which to indicate a basis for determining the probable useful life. Generally, the rate which is in effect today on metal airplanes is four years. On motors, which are depreciated on an hourly basis, the life varies between 3,500 hours and 5,000 hours, depending upon the type, with an average of, say, 4,000 hours. On propeller blades and hubs the rate, which in most cases is based on the manufacturer's expectancy of life, is about 4,000 hours. The aircraft radio is generally given a life of from two to five years, depending upon the type of radio installed in the equipment. Under the new Classification of Accounts, residual values are placed on the airplanes and engines.

The accuracy of the present rate of depreciation will, however, depend upon a number of factors: the development of new aircraft, because this will in turn influence obsolescence of the present equipment; the time factor in relation to the speed with which airports and other facilities necessary to accommodate the large equipment are completed; and the length of the period under which the present equipment can be physically maintained and economically operated.

Allocation Revenue and Expense to Routes

The above is a synopsis of the treatment of the various revenue and expense groups. Having determined the totals of each class of revenue and expense for the entire system, it is necessary to allocate these to the various air mail routes. American Airlines has eight contract routes, and in order that proper allocation of revenue and expenses could be made, it was necessary to determine a code for distribution procedure. Some of the charges are based on airplane miles; some on passenger miles; some on a combination of several factors. For example, the following excerpt from our bases of allocation will give an idea of

the bases which are to be used and the prorations to be made for heat, light and power at our Newark station:

SYMBOL

D. Each item of expense debited to the appropriate account during the accounting period is earmarked to a specific station. The accumulated expense of each station is then prorated to the air mail routes and non-mail route utilizing the station's facilities on the basis of number of arrivals, departures and basings, weighted to give effect to the estimated variation in expense as between types of equipment. The unit values used in weighting are as follows:

Type of Equipment	*One Arrival*	*One Departure*	*One Basing*
Douglas DST	5	5	12
Douglas DC-3	4	4	11
Douglas DC 2	3	3	10

Another illustration of the proration required in order to allocate charges to individual air mail routes is the handling of propeller maintenance. We quote from our bases of allocation as follows:

SYMBOL

T. The expense of propeller maintenance is accumulated in the appropriate accounts for the entire system, and each account is in turn prorated to types of airplanes on the basis of hours flown, weighted by the following units which give effect to the estimated variation in propeller maintenance expense of the various types of airplanes:

Type of Equipment	*Number of Units*
Douglas Flagships	9
Douglas DC-2	9
Stinson "A"	6
Stinson Reliant	2
Stearman	2

After propeller expense has been allocated to types of airplanes, it is distributed to air mail routes and other services on the basis of hours flown by types.

In other words, while a number of our charges can be made direct to the air mail route, there are certain points at which we have joint facilities serving more than one air mail route. We have been able to develop a basis of allocation based on past experience which will result in equitable charges to the individual air mail routes.

Expense Control

In the above we have attempted to give a brief outline of the accounting for the major groups of revenue and expenses. As to the method of control, aside from advertising, which can readily

be budgeted, our business does not yet lend itself to ordinary budgeting procedure. The principal control is through statistical and comparative statements. Some of these are kept on a day-to-day basis; some, semi-monthly; and some, monthly. Details of expenses at each point on the system, both operating and sales, are furnished to the various department heads, who are intimately acquainted with the activities at each point and the seasonal trends of traffic. For example, in our monthly financial statement we furnish a schedule of operating and traffic statistics. This statement shows the following information as to each trip: miles scheduled, scheduled miles flown, percentage of operation, revenue passengers carried, revenue passenger miles, average passengers per mile, pounds of mail carried, pound miles flown, average mail load, pounds of express carried, pound miles flown, and average load of express per mile. Comparing the trend of business as shown by this statement together with the amount of activities as revealed by the statement, enables the various departments to immediately check any adverse trend of expenses. At the same time, if this exhibit indicates that business on a particular schedule is falling off, the schedule may be moved to a different departure time or other remedial action taken. Should the day-to-day figures indicate the approach of any unusual condition, the statistical department points this out promptly by furnishing interim statements and analyses.

Inventory Control

The control of inventory is a major problem in our industry. In our own company, operating three different types of equipment, it is necessary for us to have a supply of parts at numerous locations throughout the country, which makes a relatively large investment in parts compared with our investment in equipment. The standards of maintenance of this industry are very high and complete inspections are made by licensed mechanics at each terminal point. If during these inspections it is considered advisable to remove and replace any part, this is immediately done, and it is therefore necessary that we maintain sizable stocks at the major terminals throughout the country. In American Airlines, the principal stockroom exercises a control over the entire system, generally through the medium of a stock supervisor,

whose responsibility it is to see that proper stocks are maintained at all points and that parts removed are transferred to the central base for disposition.

The control of purchases is through the purchasing department in collaboration with the general storekeeper and the operations and maintenance departments. For example, the maintenance department will advise that during a particular month fifty G-2 engines are due for overhaul. The stores department will determine the amount of parts required, taking into consideration the quantity presently available and on order. On all other purchasing matters, certain approvals are required in advance. When capital assets are required, an authorization for capital expenditure must be prepared in advance, giving all details of the transaction, including the purpose for which intended, cost, and advantages to be obtained.

There are three major points of control. In our own organization the Vice President in Charge of Sales has control of all ticket offices, sales personnel, reservations, publicity, and advertising. The Vice President in Charge of Operations controls all movements of equipment, flying personnel, maintenance and overhaul of equipment, and all ground personnel, including radio and other communications, and all ground facilities. The Treasurer has control of all purchases of fixed assets, inventories, and supplies, as well as all accounting, statistical, and financial statements. All payroll is paid from the central office and all insurance is controlled by the Treasurer. All disbursements are made through the general Treasury office.

Place of American Aviation

American aviation leads the world today. One can get an idea of the strides which this industry has made by comparing some of the figures at the Chicago Airport with the airports at London, Paris, and Berlin. In July, 1937, the average number of passengers loaded per day at the Chicago Airport was 476. For the year 1936, the figures on foreign airports were:

Croydon	163
LeBourget	131
Tempelhof	158

In other words, during July, 1937 there were as many passengers loaded at Chicago per day as the average of all three foreign airports for the year 1936.

The tons of mail loaded at Chicago for the month of July, 1937, was 103. The monthly average of the three foreign airports for the year 1936 was:

Croydon	24
LeBourget	18
Tempelhof	51

Here again, Chicago Airport handled as much air mail as all three combined.

Aviation is still in its infancy. The last few years have been full of sudden changes and rapid developments, all of which have placed a heavy burden on the accounting and financial officers, as well as on our operating people. We are looking forward to a continuation of the development of this important link in American transportation. We who have been with the industry during its period of development have attempted to set up an accounting system which will be adequate for all future developments. We believe that the present system is fundamentally sound and flexible enough to be adapted to take care of the larger volume of the future and the changing requirements.